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(56) Documents Cited
GB 2308459 A GB 2285329 A GB 2225894 A
US 5406305 A

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(54) Abstract Title
Screen brightness control

(57) A screen-illuminating panel for a backlit LCD is intermittently adjusted at predetermined time intervals to an optimal brightness level varying with the ambient illumination. The screen-illuminating panel is driven to hold the optimal brightness level while the screen-illuminating panel is not adjusted. A timer is used to detect a lapse of a time period to produce a timing signal after a trigger signal is received, and a power controller supplies power for brightness adjustment when the timing signal is received from the timer and outputs the trigger signal to the timer when the screen-illuminating panel has been adjusted.

FIG. 1

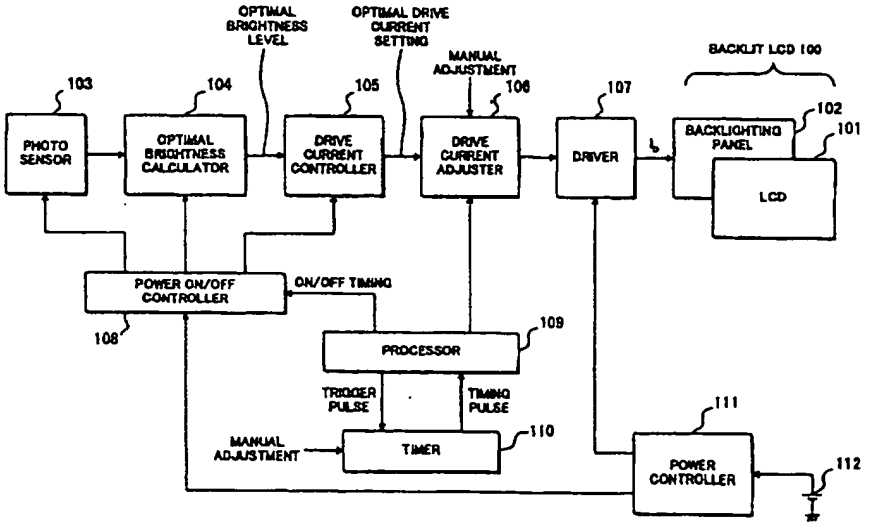

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FIG. 1

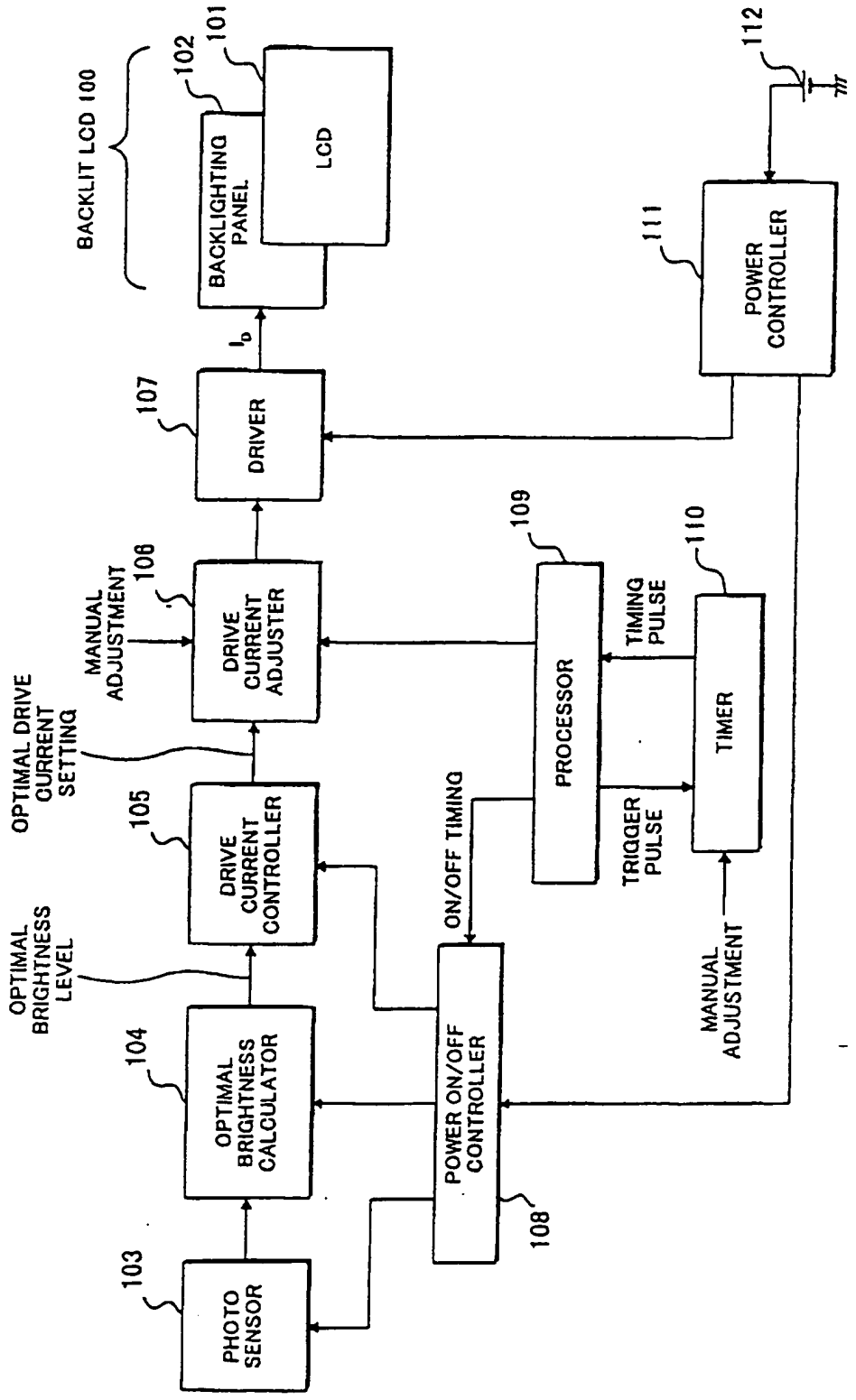

BACKLIT LCD 100
101
LCD
102
BACKLIGHTING PANEL
I_b
107
DRIVER
112
111
POWER CONTROLLER
MANUAL ADJUSTMENT
106
DRIVE CURRENT ADJUSTER
109
PROCESSOR
110
TIMER
TIMING PULSE
TRIGGER PULSE
OPTIMAL DRIVE CURRENT SETTING
105
DRIVE CURRENT CONTROLLER
ON/OFF TIMING
OPTIMAL BRIGHTNESS LEVEL
104
OPTIMAL BRIGHTNESS CALCULATOR
POWER ON/OFF CONTROLLER
108
MANUAL ADJUSTMENT
103
PHOTO SENSOR

FIG. 2

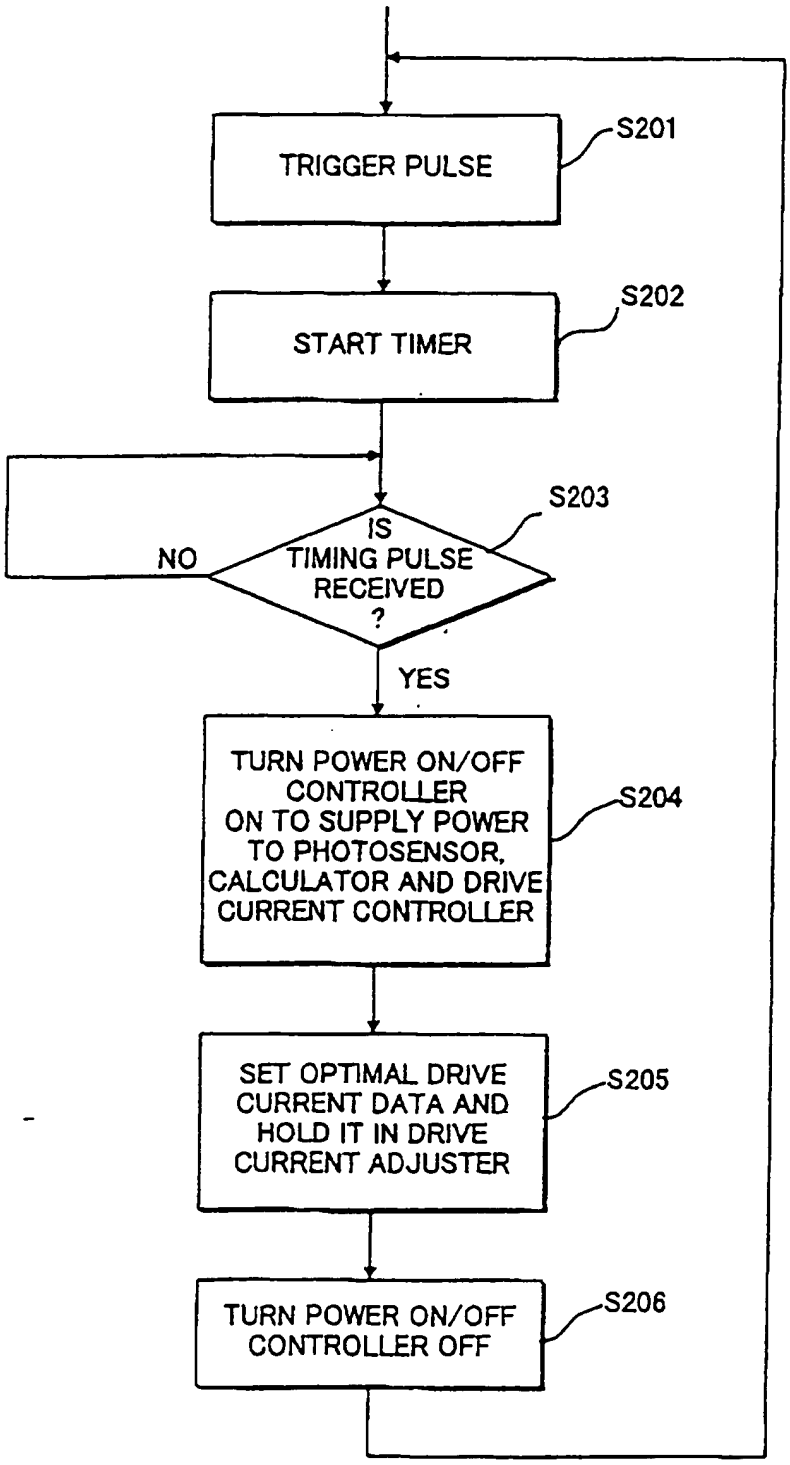
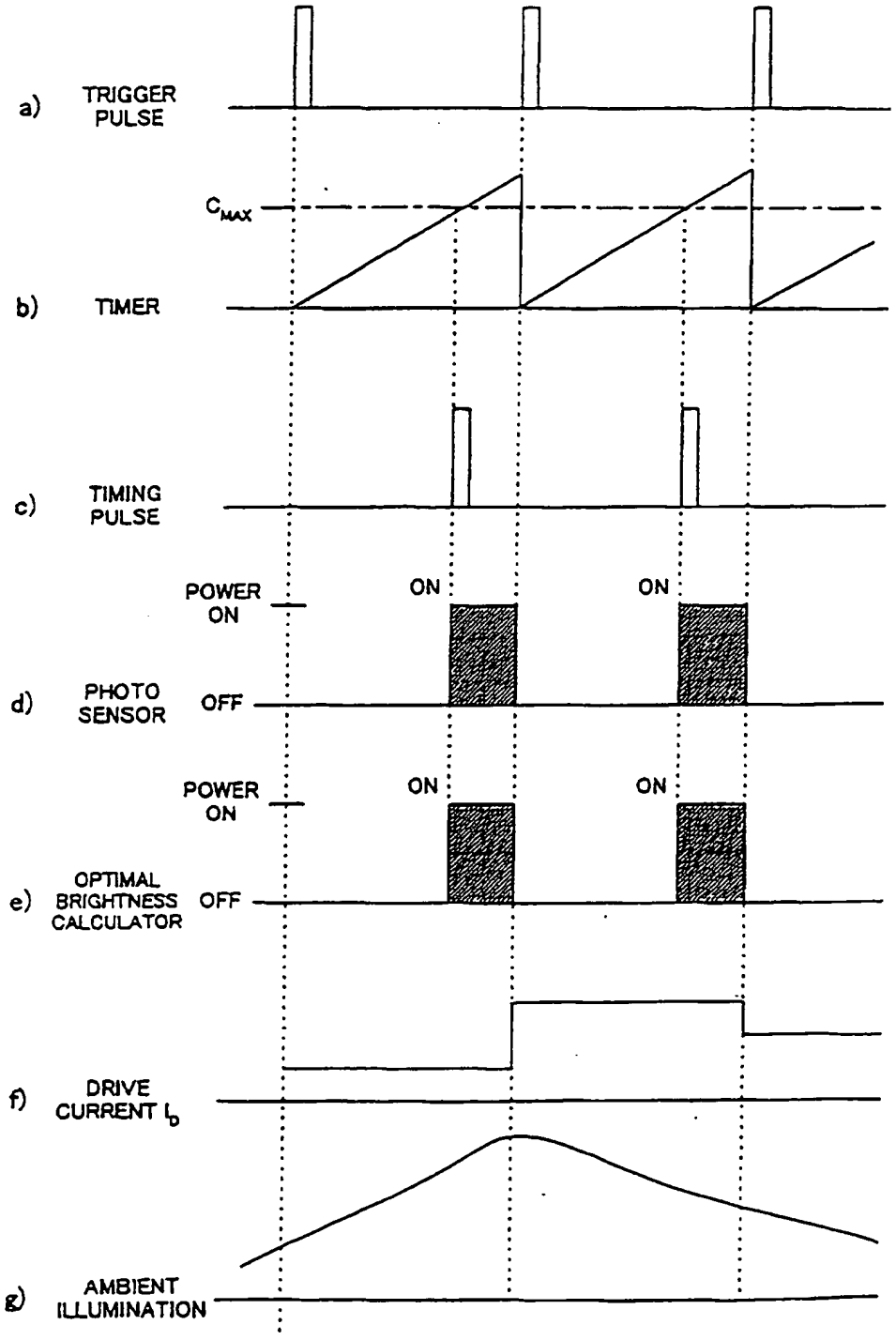

TRIGGER PULSE
S201
START TIMER
S202
IS TIMING PULSE RECEIVED ?
S203
NO
YES
TURN POWER ON/OFF CONTROLLER ON TO SUPPLY POWER TO PHOTOSENSOR, CALCULATOR AND DRIVE CURRENT CONTROLLER
S204
SET OPTIMAL DRIVE CURRENT DATA AND HOLD IT IN DRIVE CURRENT ADJUSTER
S205
TURN POWER ON/OFF CONTROLLER OFF
S206

FIG. 3


a)
TRIGGER PULSE
C_{MAX}
b)
TIMER
c)
TIMING PULSE
POWER ON
ON
ON
d)
PHOTO SENSOR
OFF
POWER ON
ON
ON
e)
OPTIMAL BRIGHTNESS CALCULATOR
OFF
f)
DRIVE CURRENT I_b
g)
AMBIENT ILLUMINATION

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SCREEN BRIGHTNESS CONTROL

The present invention generally relates to screen brightness control, and in particular to a control method for a screen-illuminating panel.

Backlit LCD displays have been widely used in handy or laptop computers and small, battery-powered electronic devices. To further improve the LCD screen's readability, there have been proposed backlit LCD displays which are capable of automatically adjusting their brightness depending on ambient illumination.

In Japanese Patent Unexamined Publication No. 5-265401, a backlit LCD system is provided with a photo sensor and a brightness controller. The brightness controller calculates the optimal level of brightness based on illumination data received from the photo sensor, and then controls the drive current supplied to the backlighting panel so that the calculated optimal brightness is obtained on the LCD screen.

A backlit LCD display improves the LCD screen's readability but draws more power than an ordinary LCD display does. Therefore, it is desirable to be able to reduce power consumption, especially in the case of a battery-powered device such as a mobile telephone terminal.

An object of at least the preferred embodiment of the present invention is to provide a screen-illumination control method and system which can achieve a reduction in power consumption.

In a first aspect the present invention provides a control system for a screen-illuminating panel having a variable brightness, comprising means for adjusting said screen-illuminating panel to an optimal brightness level depending on ambient illumination, means for controlling said screen-illuminating panel to hold the optimal brightness set by the adjusting means, and means for operating the adjusting means at predetermined time intervals periodically to adjust said screen-illuminating panel.

A preferred embodiment of a control system for a screen-illuminating panel which is variable in brightness is comprised of an adjuster for adjusting the screen-illuminating panel to an optimal brightness level varying depending on ambient illumination. The control system is characterized by a driving controller for driving the screen-illuminating panel to hold the optimal brightness set by the adjuster; and a controller for operating the adjuster at predetermined time intervals to intermittently adjust the screen-illuminating panel.

The control system may be provided with a timer for detecting a lapse of a time period to produce a timing signal after a trigger signal is received, and a power controller for supplying power to the adjuster when the timing signal is received from the timer and outputting the trigger signal to the timer when the adjuster has adjusted the screen-illuminating panel.

In a second aspect, the present invention provides a control system in a mobile information processing device, comprising a backlit screen display which has a

variable brightness, a photo detector for detecting ambient illumination of the backlit screen display, an adjuster for adjusting the backlit screen display to an optimal brightness level depending on the ambient illumination detected by the photo detector, a driving controller for driving the backlit screen display to hold the optimal brightness set by the adjuster, and a controller for operating the photo detector and the adjuster at predetermined time intervals to intermittently adjust the backlit screen display.

The present invention also extends to a method of controlling a screen-illuminating panel e.g. behind an LCD display, comprising the steps of a) adjusting the screen-illuminating panel to an optimal brightness level depending on ambient illumination, b) controlling the screen-illuminating panel to hold the optimal brightness, and c) performing the step a) at predetermined time intervals periodically to adjust the screen-illuminating panel.

Preferred features of the present invention will now be described, purely by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a block diagram showing a backlit-LCD control system.

Fig. 2 is a flowchart showing a backlighting control

operation of the system of Fig. 1; and

Fig. 3 is a time chart for explanation of the backlighting control operation of Fig. 2

Referring to Fig. 1, a backlit LCD display 100 is comprised of an LCD display 101 and a backlighting panel 102 which illuminates the back of the LCD screen. The backlighting panel 102 may be an electroluminescent panel placed behind the LCD screen.

The backlighting control system is provided with a photo sensor 103 which detects the ambient illumination of the LCD screen at controlled time intervals. The photo sensor 103 outputs ambient illumination data to an optimal brightness calculator 104 which calculates an optimal level of brightness at which a user can read information on backlit screen without causing eyestrain. The calculation is performed according to a predetermined expression at the controlled time intervals. When receiving the optimal brightness level data from the optimal brightness calculator 104, a drive current controller 105 produces optimal drive current setting data which causes the backlighting panel 102 to be set to the optimal brightness level at the controlled time intervals.

A drive current adjuster 106 receives and holds the optimal

drive current setting data. The drive current adjuster 106 sets a driver 107 so that the optimal drive current I_o is supplied to the backlighting panel 102. For example, the drive current adjuster 106 performs the pulse width control of the drive current I_o depending on the optimal drive current setting data. In this embodiment, the drive current adjuster 106 can be manually adjusted by a user twisting a potentiometer for brightness control (not shown).

The photo sensor 103, the optimal brightness calculator 104 and the drive current controller 105 are supplied with power at the controlled time intervals. Such an intermittent power control is performed by a power on-off controller 108 under the control of a processor 109. The time interval of the intermittent power control is adjusted by a timer 110 which can be set to a manually adjustable time period. More specifically, the timer 110 is reset for the adjusted time period and starts counting when receiving a trigger pulse from the processor 109. When counting the time period, the timer 110 outputs a timing pulse back to the processor 109. According to the timing pulse, the processor 109 controls the power on/off controller 108 to supply power to the photo sensor 103, the optimal brightness calculator 104 and the drive current controller 105 for illumination detection and optimal brightness control.

A power controller 111 connected to a battery 112 supplies power to the driver 107 and the power on/off controller 108. The driver 107 supplies the drive current I_o to the backlighting panel

102 depending on the optimal drive current setting data produced by the drive current controller 105. The processor 109 controls the driver current adjuster 106 according to the on/off timing. More specifically, when the photo sensor 103, the optimal brightness calculator 104 and drive current controller 105 are powered on, the drive current I_D is varied depending on the calculated optimal brightness level. On the other hand, during a power-off period, the drive current I_D is kept at a current corresponding to the latest optimal brightness level.

The optimal brightness calculator 104 calculates the optimal brightness level L using the following expression: $L = L_1 + (R-R_1) \times (L_2-L_1) / LOG(R_2-R_1)$, where L_1 is a reference brightness level at lowest performance of the photo sensor, L_2 is a reference brightness level at highest performance of the photo sensor, R is an illumination level detected by the photo sensor, R_1 is a minimum illumination level detected by the photo sensor, and R_2 is a maximum illumination level detected by the photo sensor.

Referring to Fig. 2, when the power is turned on, the processor 109 outputs a trigger pulse to the timer 110 (step S201). The trigger pulse causes the timer 110 to be reset for an adjustable time period and start counting (step S202).

The processor 109 checks whether the timing pulse is received from the timer 110 (step S203). When receiving the timing pulse (YES in step S203), the processor 109 turns on the power ON/OFF controller 108 so that power is supplied to the photo sensor 103, the optimal brightness calculator 104 and the drive

current controller 105 (step S204). This causes ambient illumination measurement and optimal brightness calculation. After the optimal drive current setting data has been set and held in the drive current adjuster 106 (step S205), the power ON/OFF controller 108 is turned off so that power is not supplied to the photo sensor 103, the optimal brightness calculator 104 and the drive current controller 105 (step S206). Subsequently, control goes back to the step S201 where the processor 109 outputs the trigger pulse to the timer 110.

In this manner, ambient illumination measurement and optimal brightness control are intermittently performed at the time intervals determined by the timer 110. An example of operation will be described hereinafter in detail.

As shown in Fig. 3, it is assumed that the timer 110 is reset for C_{max} and the ambient illumination becomes higher with time (see b) and g) of Fig. 3).

When the processor 109 outputs a trigger pulse to the timer 110, the timer 110 is reset for the maximum count C_{max} and starts counting (see f) of Fig. 3). When the timer 110 exceeds the maximum count C_{max}, the timer 110 outputs the timing pulse (see c) of Fig. 3). When receiving the timing pulse, the processor 109 turns on the power ON/OFF controller 108 so that power is supplied to the photo sensor 103, the optimal brightness calculator 104 and the drive current controller 105 (see d) and e) of Fig. 3). The optimal brightness calculator 104 calculates an optimal brightness level depending on the ambient illumination detected by the photo sensor

103. When the optimal drive current setting data has been set and held in the drive current adjuster 105, the driver 107 supplies the optimal drive current ID to the backlighting panel 102. At the same time, the power ON/OFF controller 108 is turned off so that power is not supplied to the photo sensor 103, the optimal brightness calculator 104 and the drive current controller 105 (see d) and e) of Fig. 3).

In this manner, ambient illumination measurement and optimal brightness control are intermittently performed at the time intervals determined by the timer 110. With varying ambient illumination, the brightness of the backlighting panel 102 becomes higher or lower so as to improve the screen's legibility.

Each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features.

The text of the abstract filed herewith is repeated below as part of the specification.

A screen-illuminating panel for a backlit LCD is intermittently adjusted at predetermined time intervals to an optimal brightness level varying with the ambient illumination. The screen-illuminating panel is driven to hold the optimal brightness level while the screen-illuminating panel is not adjusted. A timer is used to detect a lapse of a time period to produce a timing signal after a trigger signal is received, and a power controller supplies power for brightness adjustment when the timing signal is received from the timer and outputs the trigger signal to the timer when the screen-illuminating panel has been adjusted.

CLAIMS

1. A control system for a screen-illuminating panel having a variable brightness, comprising;

means for adjusting said screen-illuminating panel to an optimal brightness level depending on ambient illumination;

means for controlling said screen-illuminating panel to hold the optimal brightness set by the adjusting means; and

means for operating the adjusting means at predetermined time intervals periodically to adjust said screen-illuminating panel.

2. A control system according to Claim 1, wherein the adjusting means comprises:

means for detecting the ambient illumination;

means for calculating the optimal brightness level from the ambient illumination detected by the detecting means to adjust said screen-illuminating panel to the optimal brightness level.

3. A control system according to Claim 1 or 2, wherein the operating means comprises:

timer means for receiving a trigger signal and producing a timing signal a predetermined period of time after the receipt of the trigger signal; and

means for supplying power to the adjusting means when the timing

signal is received from the timer means and outputting the trigger signal to the timer means when the adjusting means has adjusted said screen-illuminating panel.

4. A control system according to Claim 3, wherein the timer means is adapted to set the time period to a predetermined value.

5. A control system according to any preceding claim, wherein the adjusting means is adapted to be manually controlled to change the optimal brightness level.

6. A control system in a mobile information processing device, comprising:

a backlit screen display which has a variable brightness;

a photo detector for detecting ambient illumination of the backlit screen display;

an adjuster for adjusting the backlit screen display to an optimal brightness level depending on the ambient illumination detected by the photo detector;

a driving controller for driving the backlit screen display to hold the optimal brightness set by the adjuster; and

a controller for operating the photo detector and the adjuster at predetermined time intervals intermittently to adjust the backlit screen display.

7. A control system according to Claim 6, wherein the adjuster is adapted to calculate the optimal brightness level from the ambient illumination using a predetermined mathematical expression.

8. A control system according to Claim 6 or 7, wherein the controller comprises:

a timer for receiving a trigger signal and producing a timing signal a predetermined period of time after the receipt of the trigger signal; and

a power controller for supplying power to the photo detector and the adjuster when the timing signal is received from the timer and outputting the trigger signal to the timer when the adjuster has adjusted the backlit screen display.

9. A method of controlling a screen-illuminating panel for example placed behind an LCD display, comprising the steps of:

a) adjusting the screen-illuminating panel to an optimal brightness level depending on ambient illumination;

b) controlling the screen-illuminating panel to hold the optimal brightness; and

c) performing the step a) at predetermined time intervals periodically to adjust the screen-illuminating panel.

10. A method according to Claim 9, wherein step a) comprises the steps of:

detecting the ambient illumination; and

calculating the optimal brightness level from the ambient illumination to adjust the screen-illuminating panel to the optimal brightness level.

11. A method according to Claim 9 or 10, wherein step c) comprises the steps of:

providing a trigger signal when the screen-illuminating panel has been adjusted,

providing a timing signal a predetermined period of time after the receipt of the trigger signal; and

performing the step a) in response to the timing signal.

12. A method according to Claim 9 or 10, wherein the step c) comprises the step of:

providing a trigger signal and turning power off so as not to perform the step a) when the screen-illuminating panel has been adjusted;

providing a timing signal a predetermined period of time after the receipt of the trigger signal; and

turning power on to perform the step a) in response to the timing signal.

13. A control system for a screen-illuminating panel or a control system in a mobile information processing device substantially as herein described.

14. A method of controlling a screen-illuminating panel substantially as herein described.

The Patent Office

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Application No: GB 9803124.8 **Examiner:** Andrew Fearnside
Claims searched: 1-14 **Date of search:** 6 May 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): G5C(A) (CHX)

Int Cl (Ed.6): G09G 3/34

Other: Online: WPI & JAPIO databases.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2308459 A	(NEC CORPORATION)	
A	GB 2285329 A	(NEC CORPORATION)	
A	GB 2225894 A	(NEC CORPORATION)	
A	US 5406305	(MATSUSHITA)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.